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TESTS OF NEW INSECTICIDES AGAINST THE PEPPER WEEVIL AT ALHAMBRA, CALIFORNIA

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During the investigations of the pepper weevil at Alhambra, Calif., tests were made of the toxicity of many different materials, and some of the results have been reported. The purpose of this circular is to assemble and make available the information obtained on the toxicity of new materials[1] in comparison with insecticides commonly used against the pepper weevil.

From a practical standpoint, cryolite was found to be the best material to use for the control of the pepper weevil, and it has been recommended for this purpose (3)[2]. Therefore, in most cases cryolite will be used as a standard and the effectiveness of other materials will be compared with it. Because pepper fields are continually being reinfested with these weevils, materials which killed by contact were relatively ineffective. Only those which left a poisonous residue on the plants for several days were satisfactory in controlling the pepper weevil.

METHODS

Most of the laboratory tests were made on individual pepper plants grown in the back yard of the laboratory. Each plant was covered with a fiber-board cone which acted as a settling chamber and also prevented the insecticide from drifting to other plants. With the use of a precision duster (2), 1 gram of insecticide was applied to the plant through the top of the cone. The plant was then covered with a screen cage, and 10 weevils were put into the cage. The cage was examined at regular intervals for 4 or 5 days and the dead weevils were counted and removed. The mortality percentage was calculated on the basis of the dead weevils actually found, the missing ones being considered as living, but the tests were discarded whenever more than 2 weevils were missing.

1/ Most of the new materials were furnished by the Division of Insecticide Investigations.

2/ Underscored numbers in parentheses refer to Literature Cited, p. 3.

For testing the contact effect, the cage was put over the plant and the weevils were introduced and allowed to settle on the foliage. Then the insecticide was dusted onto the plant through the cage top, the precision duster being used.

In some special tests, cut twigs of bell pepper were used instead of plants. For each twig a glass tumbler of water was covered with a thin board 6 inches square with a hole in the center. The stem of the twig was thrust through the hole and a piece of paper fitted around the top to keep the weevils from falling into the tumbler. The twigs were dusted with an undetermined quantity of insecticide by use of an atomizer type of hand duster. The weevils were then introduced and the infested twig was covered with a lantern-globe cage.

LABORATORY AND FIELD TESTS, 1931 THROUGH 1939

In laboratory and field tests made during 1931 and 1932, sodium fluoaluminate, potassium fluoaluminate, ammonium fluoaluminate, magnesium fluoaluminate, and barium fluosilicate were effective against the pepper weevil, but these fluorine materials available at this time were somewhat unstable and caused slight leaf injury or bud pruning, resulting in an actual reduction in yield (1). Calcium arsenate, undiluted, was almost as toxic to the pepper weevil as the fluorine materials, but a little slower in action. These tests with calcium arsenate were very favorable, and a considerable quantity was used in commercial control of the pepper weevil. The commercial use of calcium arsenate, however, was followed by damage by aphids and a decided reduction in yield (4), especially when several applications were made.

In laboratory tests in 1936, using 30 weevils for each material, undiluted calcium arsenate gave 70 percent mortality, whereas none of the following materials gave over 40 percent mortality: Dibenzothiophene 4 and 8 percent; phenothiazine 15 percent; a mixture containing 2.7 percent of nicotine, 1.5 percent of phenothiazine, and 1.5 percent of pyridine; a mixture containing 3 percent of phenothiazine, 3 percent of pyridine, and 3 percent of pine oil.

In 1938 and 1939 field tests were made with cuprous cyanide 20 percent and 30 percent, and with a proprietary mixture containing 0.3 percent of pyrethrins. Infestations were low, but cuprous cyanide showed some promise. Bran baits containing 4 pounds of calcium arsenate and 2 to 4 pounds of molasses per 100 pounds of bran were ineffective. A spray containing 4 pounds of tartar emetic and 10 pounds of brown sugar per 100 gallons of water was also ineffective.

LABORATORY TESTS, 1940-1942

As shown in tables 1 and 2, most of the materials tested during 1940, 1941, and 1942 were ineffective as compared with calcium arsenate and cryolite. Phenazine was toxic to the weevils but caused severe burning of the

pepper plants. Phenoxathiin had to be diluted with talc before it could be used at all as a dust, and as such was relatively ineffective. Tripterygium wilfordii gave over 60 percent mortality, and it is worthy of further trials, especially as the 50-percent strength averaged better than the undiluted material. Two proprietary preparations containing pyrethrins gave high weevil mortalities when used in the laboratory as contact insecticides, but pyrethrum dusts have given unsatisfactory results under field conditions. p-Aminoazobenzene hydrochloride not only was ineffective, but was objectionable because it gave the plants a rusty color and stained the hands and clothing of the operators yellow. p-Aminoacetanilide caused definite foliage injury, especially to the growing tips. Phenazine, N-nitrosodiphenylamine, styrene dibromide, and phenoxathiin were all too coarse to be applied as dusts and had to be reground, which could not be done very satisfactorily with a mortar and pestle. Dimethylacridan became too moist and could not be ground at all. The sample of ground Tripterygium wilfordii was an excellent dust, being light and easy to apply.

LABORATORY TESTS IN 1943

In 1943 two new materials, 2-chlorofluorene and DDT, were tested, and the results, as summarized in table 3, indicate that they may be more toxic than any material previously tested. DDT was consistent in giving 100 percent mortality within 24 hours after application, but very low mortalities were sometimes obtained within this period with 2-chlorofluorene. Plants treated with DDT appear to be completely protected from weevil feeding. The weevils were not able to stay on the leaves or buds for more than a few seconds at a time. The same action was observed with twigs dusted with 2-chlorofluorene, but the weevils were affected less rapidly than with the DDT. Incidentally, the DDT dust adhered to the pepper leaves and buds much better than did the 2-chlorofluorene.

LITERATURE CITED

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1933. Some tests with fluorine compounds against the pepper weevil. Jour. Econ. Ent. 26: 1095-1105, illus.

(2) - - - - - - - - Roy E. Campbell, and C. S. Guy
1935. A method of applying insecticidal dusts quantitatively as a basis for cage tests of insecticides. U. S. Dept. Agr., Bur. Ent. and Plant Quar. Circular ET-45, 3 pp., illus. (Processed.)

(3) - - - - - - - -
1942. The Pepper Weevil. U. S. Dept. Agr. Leaflet No. 226, 8 pp., illus.

(4) - - - - - - - - and Roy E. Campbell
1943. Aphid increase and plant injury following the use of calcium arsenate on peppers. Jour. Econ. Ent. 36 (6): 853-856.

Table 1.- Mortality of pepper weevils on plants treated with insecticidal dusts, 1940 - 1942

Materials	Weevils used	Mortality
	Number	Percent
Weevils placed on dusted foliage, 1940		
Calcium arsenate	200	90
Cryolite (70% sodium fluoaluminate)	240	87
Cryolite (50% sodium fluoaluminate)	270	80
1,3-Diphenyltriazine	140	77
1,4-Diphenyl semicarbazide	150	53
Phenothiazine (30%)	140	36
Cuprous cyanide (20%)	30	33
1,3-Diphenyltriazine and bentonite (1:1)	90	32
A proprietary mixture containing pyrethrins 2%	50	32
Dinitro-o-cyclohexyl phenol 2% and dicyclohexylamine 3.35%	100	31
Cuprous cyanide (30%)	50	26
A proprietary material containing pyrethrum powder 15%, beta-butoxy-beta'-thiocyanodiethyl ether 1%, petroleum distillate 1%, and talc 83%	40	25
p-Aminobenzene hydrochloride	140	24
Dicyclohexylamine dinitro-o-cyclohexylphenate 1.7% and heavy oil 2%	100	23
p-Aminoacetanilide	100	22
Dicylcohexylamine dinitro-o-cyclohexylphenate 1.7%	100	20
1,4-Dinitrosopiperazine	100	10
Dinitro-o-cylohexylphenol 1%	70	9
1,4-Diphenyl semicarbazide and bentonite (1:1)	50	6
Weevils placed on dusted foliage, 1941		
Phthalonitrile	60	32
Phthalonitrile and talc (1:1)	70	23
p-Aminoacetanilide	60	12
p-Aminoacetanilide and talc (1:1)	70	17
1,4-Diphenyl semicarbazide	80	14
1,4-Diphenyl semicarbazide and talc	70	24
p-Aminoazobenzene hydrochloride	50	33
p-Aminoazobenzene hydrochloride and talc (1:1)	70	14
None (check)	40	10

Table 1 - continued

Materials	Weevils used	Mortality
	Number	Percent
Weevils placed on foliage before dusting, 1941		
Phthalonitrile	70	96
Phthalonitrile and talc (1:1)	60	61
p-Aminoacetanilide	80	42
p-Aminoacetanilide and talc (1:1)	80	40
1,4-Diphenyl semicarbazide	60	42
1,4-Diphenyl semicarbazide and talc (1:1)	80	55
p-Aminoazobenzene hydrochloride	70	33
p-Aminoazobenzene hydrochloride and talc (1:1)	60	33
None (check)	40	22
Weevils placed on dusted foliage, 1942		
Phenazine[1/]	40	92
Phenazine and talc (1:1)[2/]	40	42
Cryolite (70% sodium fluoaluminate)	196	82
Cryolite (50% sodium fluoaluminate)	212	77
Cryolite (35% sodium fluoaluminate)	151	75
Tripterygium wilfordii	180	64
T. wilfordii and talc (1:1)	110	67
N-Nitrosodiphenylamine	30	20
Phenoxathiin and talc (1:1)	40	28
Styrene dibromide	50	24
None (check)	140	10

1/ Caused severe burning and complete defoliation.

2/ Caused slight burning and dropping of buds.

Table 2.-Mortality of pepper weevils in tests in which 10 weevils were placed on plants before the application of insecticides and 10 weevils 4 to 10 days later

Materials	Tests conducted	Mortality of weevils dusted	Mortality of weevils placed on dusted foliage
	Number	Percent	Percent
Calcium arsenate, undiluted	24	85	75
Calcium arsenate and talc (1:1)	10	82	83
Cryolite and talc (70% sodium fluoaluminate)	20	86	64
Cryolite and talc (50% sodium fluoaluminate)	15	66	47
A proprietary material containing 15% of pyrethrum powder, 1% of beta-butoxy-beta'-thiocyanodiethyl ether, 1% of petroleum distillate and 83% talc	14	87	24
A proprietary mixture containing 2 percent of pyrethrins	15	88	25
None (check)	9	10	7

Table 3.-Mortality of pepper weevils placed on twigs of pepper after dusting with new insecticides, 1943

Materials	Strength	Weevils used	Mortality in 24 hours
	Percent	Number	Percent
2-Chlorofluorene[1/]	20	67	67
	10	30	27
DDT and pyrophyllite	10	69	100
	5	29	100
	3	31	100

1/ Diluent not known